

Dynamic ASE Modeling and Optimization of Aircraft with SpaRibs, Phase II

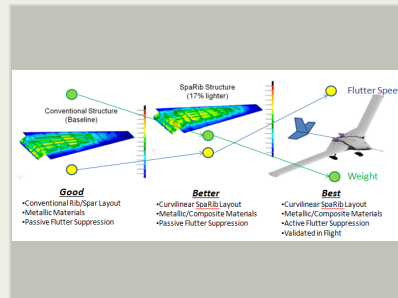
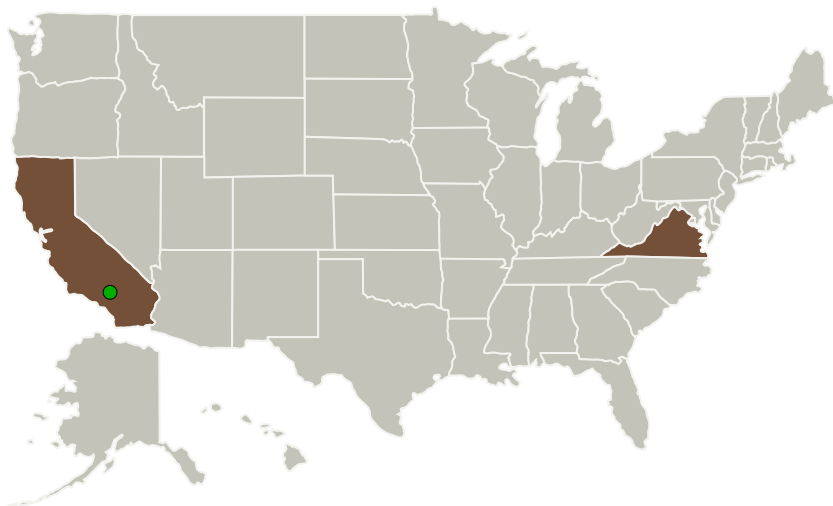
Completed Technology Project (2015 - 2017)



Project Introduction

In aircraft design, reducing structural weight is often a prime objective, while various constraints in multiple disciplines, such as structure, aerodynamics and aeroelasticity should be imposed on the aircraft. Therefore, engineers need optimization tools to incorporate the multidisciplinary constraints using appropriate fidelity during the early stages of concept design. Classic structural design of aircraft structures is based on the concept of a "wing box" that uses simple components such as straight spars and ribs, quadrilateral wing skin panels and straight stiffeners. A new design philosophy, using curvilinear SpaRibs has been introduced based on emerging manufacturing technologies such as Electron Beam Free Form Fabrication and Friction Stir Welding (FSW). In those innovative technologies, the wing structure is manufactured as an integrated part instead of using mechanically fastened structural components. This design approach makes it possible to design curved substructure that is a hybrid between spars and ribs, therefore called "SpaRibs". These can be designed to have favorable coupling between bending and torsion, and can improve the buckling resistance of local panels. The ability to tailor the bend-twist coupling has been shown to offer substantial improvement in aeroelastic behavior without a weight penalty (or alternately, a weight savings without aeroelastic problems). In this program we will advance this technology to a TRL of 5-6 (or to 6-7 in a Phase III) by designing a subsonic transport wing with better aeroelastic and aeroservoelastic performance, and by designing a test article and test program suitable for proving the performance benefits in flight.

Primary U.S. Work Locations and Key Partners



Dynamic ASE Modeling and Optimization of Aircraft with SpaRibs Project Image

Table of Contents

Project Introduction	1
Primary U.S. Work Locations and Key Partners	1
Images	2
Organizational Responsibility	2
Project Management	2
Technology Maturity (TRL)	3
Technology Areas	3
Target Destinations	3

Dynamic ASE Modeling and Optimization of Aircraft with SpaRibs,
Phase II

Completed Technology Project (2015 - 2017)

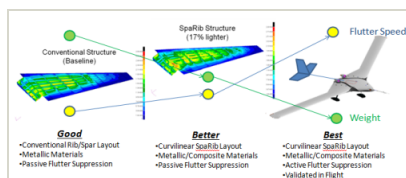


Organizations Performing Work	Role	Type	Location
M4 Engineering, Inc.	Lead Organization	Industry Women-Owned Small Business (WOSB)	Long Beach, California
● Armstrong Flight Research Center (AFRC)	Supporting Organization	NASA Center	Edwards, California
Virginia Polytechnic Institute and State University (VA Tech)	Supporting Organization	Academia	Blacksburg, Virginia

Primary U.S. Work Locations

California	Virginia
------------	----------

Images



Project Image

Dynamic ASE Modeling and Optimization of Aircraft with SpaRibs Project Image

(<https://techport.nasa.gov/image/132967>)

Organizational Responsibility

Responsible Mission Directorate:

Space Technology Mission Directorate (STMD)

Lead Organization:

M4 Engineering, Inc.

Responsible Program:

Small Business Innovation Research/Small Business Tech Transfer

Project Management

Program Director:

Jason L Kessler

Program Manager:

Carlos Torrez

Principal Investigator:

Myles Baker

Co-Investigator:

Myles Baker

Dynamic ASE Modeling and Optimization of Aircraft with SpaRibs, Phase II

Completed Technology Project (2015 - 2017)



Technology Maturity (TRL)

Start: **4**
Current: **5**
Estimated End: **5**



Technology Areas

Primary:

- TX12 Materials, Structures, Mechanical Systems, and Manufacturing
 - └ TX12.2 Structures
 - └ TX12.2.5 Innovative, Multifunctional Concepts

Target Destinations

The Sun, Earth, The Moon, Mars, Others Inside the Solar System, Outside the Solar System